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**The Impact of the North American Free Trade Agreement on the Water Resources
of Mexico**

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A paper submitted to the Faculty of the Naval War College in consideration for the
Jerome E. Levy Economic Geography and World Order Prize

The contents of this paper reflect my own personal views and are not necessarily
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10 April 2004

The North American Free Trade Agreement between the United States, Mexico, and Canada contained so-called Environmental Side Agreements designed to enhance and protect the environment during the course of the expected increase in trade between the three countries. While some U.S. environmental groups hailed the Side Agreements as a first step toward linking increased trade with regional sustainable development, others saw the Side Agreements as a means to simply shift environmental degradation to countries with the weakest environmental protection. Much of the debate surrounding the efficacy of NAFTA centers on Mexico's water resources. As trade surges along the US-Mexico border region, population growth and increased demand has stressed both water quality and quantity in this already water-stressed region. This paper examines NAFTA in light of these water resources issues, and the effectiveness of the Environmental Side Agreements to find solutions.

The North American Free Trade Agreement (NAFTA), effected in January 1994 between the United States, Canada, and Mexico, is the first international agreement to link trade and environmental policy. While the initial version of NAFTA focused primarily on trade, successful effort by US environmental groups expanded it to link trade liberalization to environmental protection and sustainable development. As a result of this unprecedented marriage, great attention has focused on how well NAFTA is delivering on its promises. Much of this attention, analysis and debate centers on how free trade has affected the environment. The so-called NAFTA Environmental Side Agreements have designated water quality and water quantity issues as a primary focus area in this regard. In this paper, I review the progress to protect water quality and address water quantity issues, focusing on Mexico. To provide the necessary context for this analysis, I first review the broad objectives and institutions created to manage the environment under NAFTA; examine basic provisions of environmental law in the US and Mexico; and review water distribution and usage trends in Mexico. Using available data, I analyze NAFTA's efficacy in preserving and protecting Mexico's water resources, and provide recommendations for the future.

NAFTA's Environmental Background

As noted, the initial version of NAFTA was simply centered on *trade*. The concerted efforts of US environmental groups, notably the National Audubon Society, National Wildlife Federation, Natural Resources Defense Council, Environmental Defense Fund, World Wildlife Federation, and Conservation International, helped to

forge the broader linkage on trade *and the environment*.¹ Environmental groups were divided over NAFTA, however: the Sierra Club and Friends of the Earth, although the former participated in much of the negotiation process, did not favor the agreement.² In the end, despite the vociferous opposition to NAFTA by organized labor, Congress passed the basic agreement and the addendums to it which held the environmental provisions—the so-called “Environmental Side Agreements.”

These two agreements established the institutional framework to accomplish NAFTA’s general environmental goals: to “promote sustainable development” and “strengthen the development and enforcement of environmental laws and regulations.”³ NAFTA signatories “committed themselves to fulfill the trade agreement ‘in a manner consistent with environmental protection and conservation.’”⁴ To this end, NAFTA created the North American Commission for Environmental Cooperation (NACEC), charged to ensure the US, Canada and Mexico would enforce their individual environmental laws. This trilateral agency was joined by the bilateral Border Environment Cooperation Commission (BECC), whose focus was to clean up the “notorious” environmental conditions along the US/Mexico border region. Among BECC’s duties was to “coordinate and facilitate” environmental clean up projects along the border, certifying them for funding by its sister agency, the North American Development Bank (NADB).⁵ At the time of NAFTA’s signing, NADB was to be capitalized with \$450 million provided by the US and Mexico, with the ability to raise an

¹ Annette Baker Fox, *Environment and Trade: The NAFTA Case*, Political Science Quarterly. New York: Spring 1995. Vol. 110, issue 1, footnote #26.

² Ibid, p. 9.

³ Ibid, p. 5.

⁴ Ibid.

⁵ Ibid, p. 8.

additional \$2 billion through grants and loans.⁶ Both the NACEC and BECC also provided increased transparency and citizen involvement in environmental issues, something most observers considered lacking in Mexico at the time, and to which I will return later. Finally, the BECC, in particular, was charged with focusing on water quality and water quantity issues between the US and Mexico; NADB funds are preferred to be used for “water pollution, wastewater treatment, municipal solid waste and related matters.”⁷ With this background on the environmental provisions of NAFTA, a review of current environmental law in Mexico follows in order to assess BECC and NADB accomplishments to date.

Environmental Law in the US and Mexico

The US is widely regarded to have superb environmental legislation. In 1969, for example, Congress passed the landmark National Environmental Policy Act (NEPA), which established the goals and objectives that would lead to other important legislation including the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, also known as “Superfund”), and the Clean Water Act (CWA). It is important to note that these were not the first pieces of US environmental legislation; they are regarded, however, as legislation that would be rigorously enforced.

Prior to NAFTA’s passage, to address concerns that it would create “pollution havens” for industry (and thus lead to environmental degradation), the US Environmental Protection Agency (EPA) studied US and Mexican environmental laws. With certain

⁶ Ibid.

⁷ Cyrus Reed and Mary Kelly, *Expanding the Mandate: Should the Border Environment Cooperation Commission and North American Development Bank go beyond Water, Wastewater and Solid Waste Management Projects and How Do They Get There?* July 2000, Texas Center for Policy Studies, p. 7.

exceptions, EPA found that Mexican environmental laws “are designed to achieve comparable levels of environmental protection” as US laws.⁸ As early US experience demonstrated, however, it is one thing to have laws on the books, and quite another to achieve effective enforcement of them. For example, while US EPA regulations require a permit to discharge pollutants into rivers, lakes and other waters of the US, Mexico has no such permit system.⁹ Moreover, while US environmental policy is built upon active citizen involvement (providing in effect “eyes and ears” for Federal and State regulators), aided by the Freedom of Information Act (FOIA), Mexico lacks the mechanisms to provide similar, effective involvement and environmental data to her citizens.¹⁰ While the NACEC and BECC contain provisions to effect increased citizen participation, and more environmental information is available now than prior to NAFTA, enforcement of Mexico’s environmental regulations is largely left to an organization similar to an “attorney general type office”, known as the *Procuraduria Federal para la Proteccion Ambiental*, or Profepa.¹¹

Unlike the US EPA, Profepa is generally seen as lacking the resources and authority to effectively regulate polluters and enforce environmental regulations.¹² For example, only 13% of industrial wastewaters are treated in Mexico, and less than 1/3 of industries comply with discharge legislation.¹³ One author notes that while Mexico’s manufacturing sector “has grown 4 percent per annum since enactment of NAFTA, real

⁸ US Government Printing Office, *The NAFTA: Report on Environmental Issues*, November, 1993, p. 25.

⁹ Vera S. Kornylak, Esq., *Improving Wastewater Infrastructure along the Arizona-Mexico Border: An Analysis of Trends and Ideas*, October 2000, pp. 429-431.

¹⁰ Ibid.

¹¹ Ibid, p. 431.

¹² This is the general conclusion of Kornylak and others, and it represents a defect in the NACEC provisions. That is, both the NACEC and the BECC have little clout in compelling NAFTA signatories to enforce their own environmental regulations. (I should note here, however, that US EPA is under funded in some areas, as well.)

¹³ Water and Waste International, vol. 18, no. 3, p. 25. May 2003.

spending on pollution monitoring and on-site inspections has fallen by 45 percent over the same period.”¹⁴ It is unlikely NAFTA is responsible for this effect, however.

Accordingly, while Mexico and the US may share similar environmental protection regulations and goals, a real environmental quality gap persists between the two countries. At this point it is important to note that environmental quality along the US-Mexico border region is problematic for both governments, and it appears clear that the US EPA has been somewhat less attentive to environmental issues along the border in the past than to other regions of the US. This view is shared by Kornylak, who notes that there are no EPA personnel assigned to work in Arizona—a signal that perhaps more could be done on the US side to address border environmental issues. Later I will highlight recent EPA progress toward this end under the auspices of the so-called Border 2012 Program.

Water Distribution and Usage Trends in Mexico

An analysis of NAFTA’s effects on water quality and quantity issues in Mexico would be incomplete, and misleading, without a general review of Mexico’s water resources. With the institutional and environmental law framework in mind, I now turn to an analysis of water distribution and usage trends in Mexico.

Degradation of Mexico’s water resources is exacerbated by an arid climate and low annual rainfall patterns. As Figure 1 shows, Mexico’s rainfall is about 738 millimeters annually, or about 29 inches. Most of the rainfall is concentrated in the mountainous regions, where little population, industry, or agriculture exists.

¹⁴ Scott Vaughan, *The Greenest Trade Agreement Ever?* Carnegie Endowment for International Peace. Feb 13, 2004, p. 67.

Country	Rainfall	Country	Rainfall
Antigua and Barbuda	2,515.1	Guatemala	2,719.4
Argentina	552.3	Guyana	2,353.9
Bahamas, The	1,298.0	Haiti	1,493.1
Barbados	552.3	Honduras	1,790.8
Belize	2,372.1	Jamaica	1,980.1
Bolivia	1,047.5	Mexico	738.1
Brazil	1,736.2	Nicaragua	2,179.4
Chile	711.7	Panama	2,596.4
Colombia	2,633.7	Paraguay	1,092.6
Costa Rica	2,842.2	Peru	1,407.9
Cuba	1,293.7	Puerto Rico	1,873.4
Dominica	1,293.7	St. Kitts and Nevis	1,900.1
Dominican Republic	1,388.8	St. Lucia	1,864.4
Ecuador	1,890.1	Suriname	2,267.2
El Salvador	1,711.7	Trinidad and Tobago	1,809.8
French Guyana	2,674.4	Uruguay	1,199.6
Grenada	2,583.3	Venezuela	1,979.9
Guadeloupe	2,707.1		

Source: Based on data supplied by the Climate Impacts LINK Project (UK Dept. of the Environment Contract EPG 1/1/16) on behalf of the Climatic Research Unit, University of East Anglia

Figure 1: Average annual rainfall in Latin American Countries, 1986-1996 (millimeters)

Note, as shown in Figure 2, that the US/Mexico border region is among the driest areas of the country. The lines (isohyets) in Figure 2 represent millimeters of rainfall; the border region is outside the 250 mm isohyet (just over 10 inches of rainfall/year).

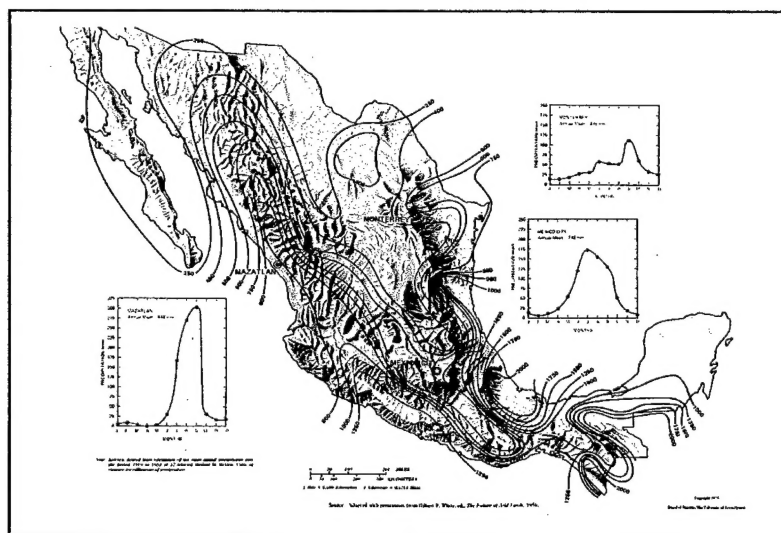


Figure 2: Mean Annual Precipitation Mexico¹⁵

¹⁵ Adapted by the University of Texas, with permission by Gilbert F. White, ed., The Future of Arid Lands, 1956.

Figure 2 offers a potential link to how NAFTA might affect water resources, in that this border region also supports concentrated agricultural activity, as seen in Figure 3.

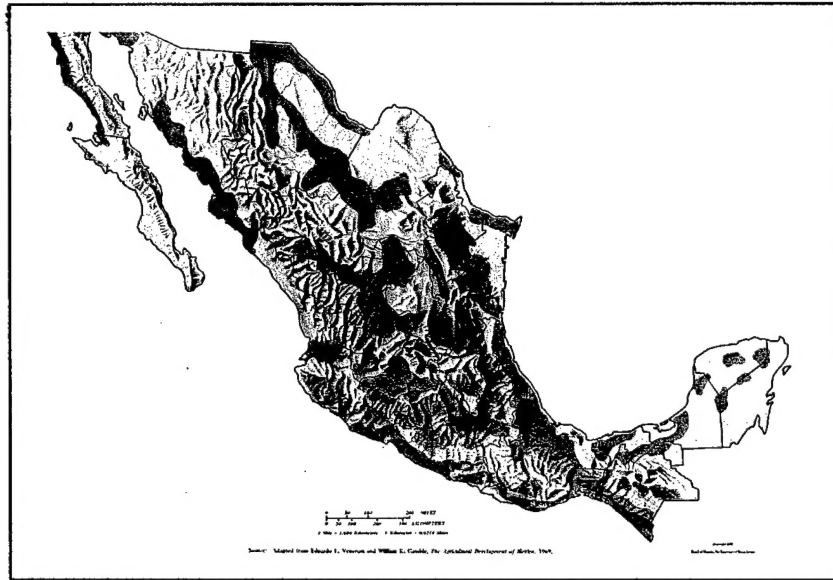


Figure 3: Major Agricultural Areas in Mexico¹⁶
(Darker areas depict concentrations)

Water resources are further stressed in that the border region has long been home to the so-called *maquiladoras*¹⁷, the “twin plant or production sharing” industry that was initially established along the border in 1965.¹⁸ While these *maquiladoras* are not “major consumers of water” themselves, the workers who migrate to the factories each year place a major burden on the ability of border cities to provide water, and process wastewater.¹⁹ Figure 4 illuminates how this industry coincides with agricultural concentration and the dearth of water resources located along the border. These three factors bear directly on water quality and quantity issues in Mexico, and they are tied to

¹⁶ Adapted by the University of Texas from Eduardo L. Venezian and William K. Gamble, The Agricultural Development of Mexico, 1969.

¹⁷ “Maquiladora is a term derived from the Spanish word *maquilar*, which is the service a miller provides when he grinds wheat into flour. Similarly, a maquiladora provides assembly services without necessarily taking ownership of the goods being assembled.” US General Accounting Office, *Mexico’s Maquiladora Decline Affects US-Mexico Border Communities and Trade; Recovery Depends in Part on Mexico’s Actions*, Report #03-891, July 2003, p. 5.

¹⁸ New Mexico Economic Development, *Maquiladora and Border Data*, <http://www.edd.state.nm.us/TRADE/BORDER/borderdata.html>, accessed Feb 9, 2004.

¹⁹ Not a Drop to Drink, <http://pbs.org/kpbs/theborder/about/notadropdrink.html>, accessed Feb 9, 2004.

increased trade driven by NAFTA. Insofar as US agriculture is the leading source of pollution in “57 percent of river miles, 30 percent of lake acres, and 15 percent of

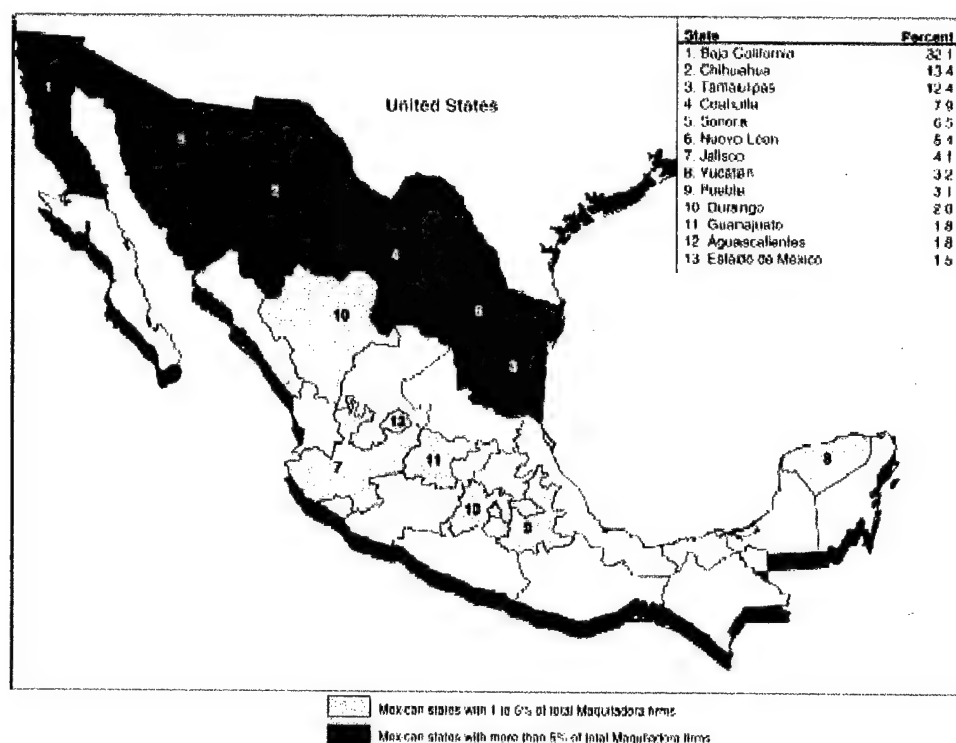


Figure 4: Map of Mexico showing Share of Maquiladora Establishments, by State²⁰
 (Darker areas contain higher concentration of Maquiladoras)

estuarine waters,”²¹ there is every reason to suspect that increased agriculture production in Mexico, coupled with a lax environmental regulation enforcement climate, has degraded water resources.

NAFTA and the State of Water Resources in Mexico

In 1994, trade between the US and Mexico amounted to \$88 billion; by 2001, trade had risen to \$350 billion.²² While the consensus among economists is that NAFTA

²⁰ US GAO Report #03-891, p. 11.

²¹ Joseph Cooper, Robert Johansson, and Mark Peters, *Some Domestic Environmental Effects of US Agricultural Adjustments under Liberalized Trade; a Preliminary Analysis*. March 18, 2003, p. 6.

accounts for only part of this increase, the agreement has nevertheless impacted the Mexican economy, the migration of jobs, and the concentration and growth of agricultural and industrial sectors. For example, half of the 3.5 million jobs created in Mexico during the period 1995-2000 are attributed to NAFTA, and “growth in Mexican exports accounted for more than half the increase in Mexico’s real national income” during 1993-2001.²³ Moreover, some of the fastest growing cities in the US and Mexico are along the border region.²⁴ All of this growth has placed a tremendous burden on Mexico’s water resources; part of the problem is the lack of infrastructure to provide fresh water and convey, and then treat, wastewater.

Much of the growth has occurred in the agricultural sector, and, as Figure 5 (following page) shows, this growth has important ramifications for water resources and NAFTA. Mexican farm exports to the US “increased by 103% from 1993-2000, and are growing twice as fast as they did before NAFTA.”²⁵ Exports of fruit since the passage of NAFTA have increased 90 percent, and vegetable exports have increased fully 80 percent.²⁶ Researchers have concluded that fruit and vegetable exports are the main cause of man-made water stress in Mexico.²⁷ Given Mexico’s low average annual rainfall, how has it achieved such remarkable growth in its agricultural sector? One factor is the shift away from small, individual farms to larger, more efficient export-

²² *Mexico and NAFTA*, http://www.migrationint.com.au/news/palau/jan_2003-04mn.asp, accessed Feb 10, 2004.

²³ Office of the United States Trade Representative, *Myth: NAFTA was a failure for Mexico*, November 2003, www.ustr.gov.

²⁴ US GAO Report #03-891, pp. 4-5.

²⁵ *Ibid.*

²⁶ Vaughan, p. 63.

²⁷ *Ibid.*

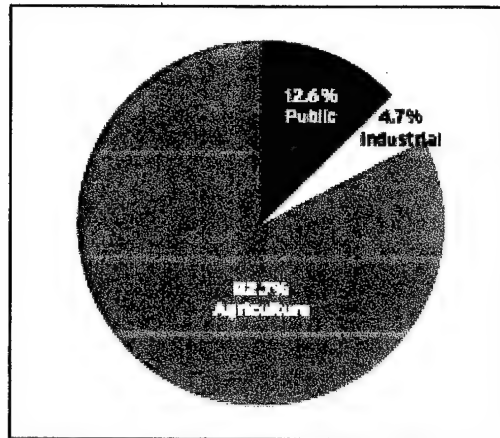


Figure 5: Distribution of Mexican Water Use²⁸

farms, which “appear to use greater amounts of irrigated water per yield.”²⁹ Other reasons include increased use of fertilizers and pesticides, as indicated in Figures 6 and 7.

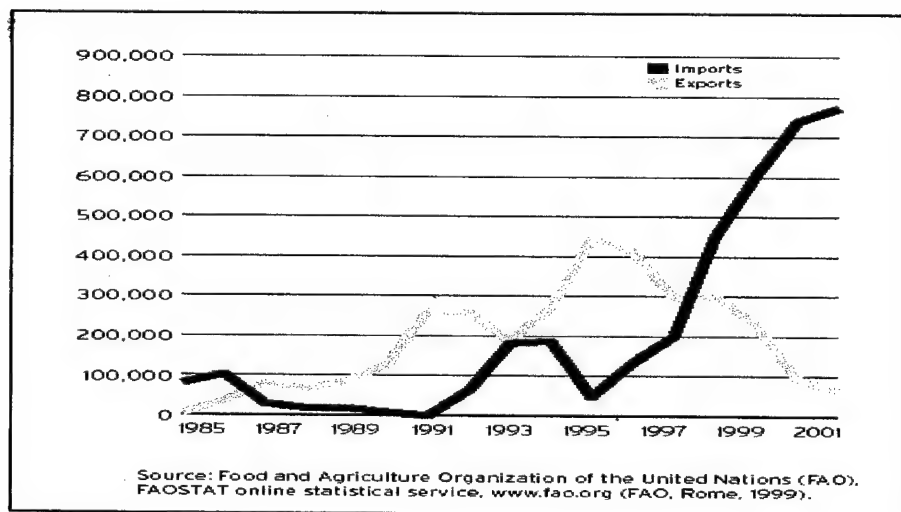


Figure 6: Mexico's Imports and Exports of Nitrogenous Fertilizers (Megatons)

²⁸ Ibid, p. 69.

²⁹ Ibid, p. 64.

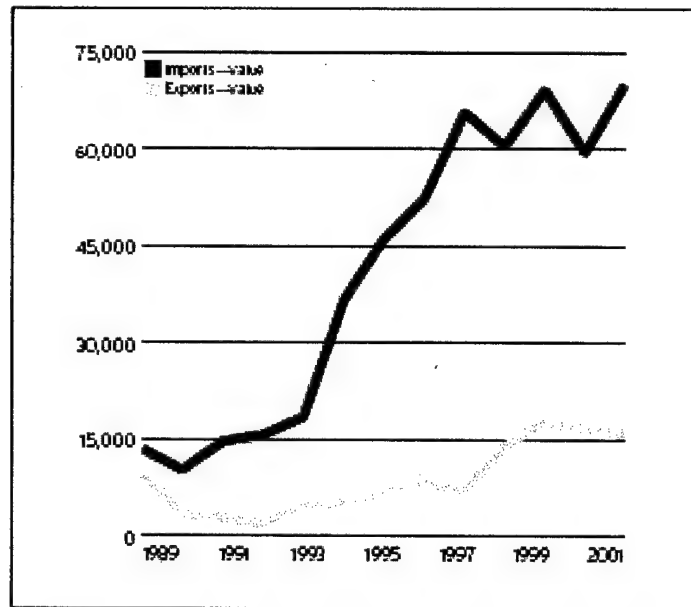


Figure 7: US Insecticide Trade with Mexico (US Dollars)

Irrigation also plays a role in degrading Mexico's water resources, through increased erosion and draw-down of groundwater aquifers. In fact, as shown by Figure 8, Mexico leads Latin American in the total amount of acreage under irrigation.

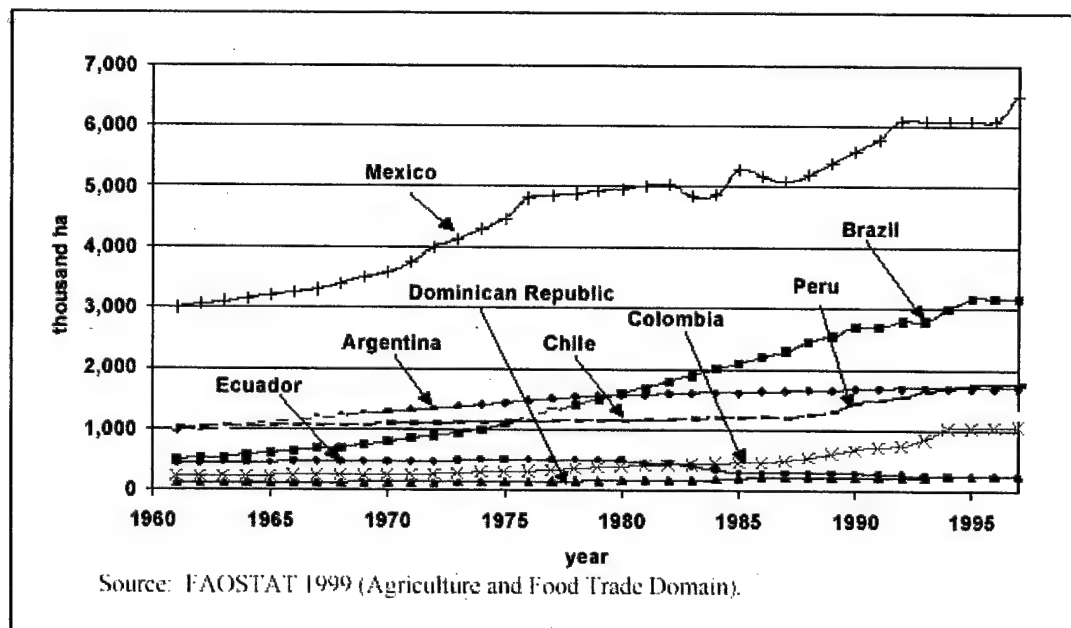


Figure 8: Irrigated area, major Latin American Countries, 1961-1997

To mitigate the effects of low annual rainfall, Mexico employs a great number of water reservoirs. In fact, Mexico leads Latin America with funded irrigation projects, as shown in Figure 9, and this has certainly allowed her to maximize limited rainfall resources.

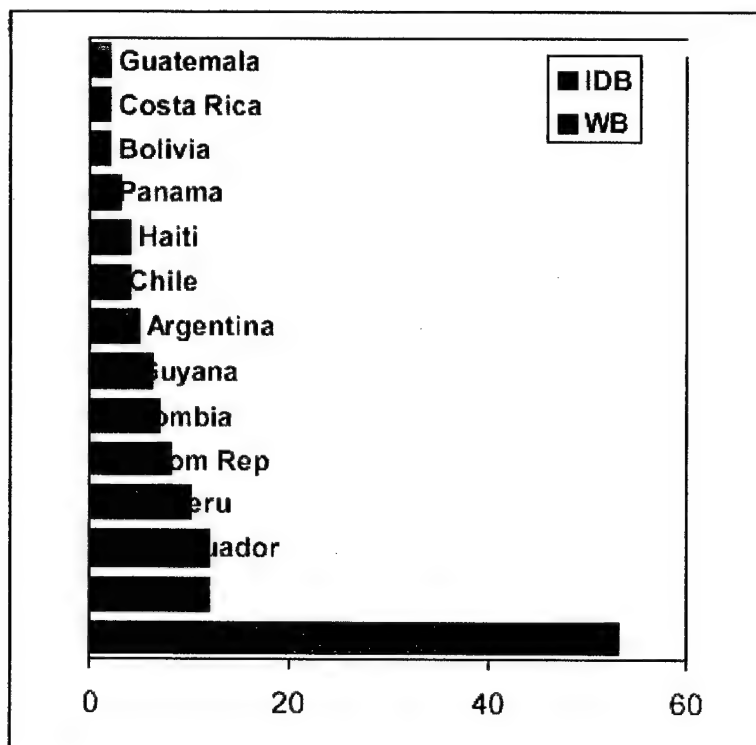


Figure 9: Number of Irrigation Projects, International Development Bank and World Bank 1961-1996³⁰

However, the combination of increased fertilizer loads and irrigation often affects surface water and groundwater quality; data show increased nitrogen and other agrochemicals in groundwater, a clear sign of fertilizer over-application, over-irrigation, or both.³¹ These trends underscore the importance of effective water resources management in Mexico, especially in light of increased growth spurred by NAFTA.

³⁰ Claudia Ringler, Mark W. Rosegrant, and Michael S. Paisner, *Irrigation and Water Resources in Latin America and Caribbean: Challenges and Strategies*, International Food Policy Research Institute, June 2000, p. 66.

Some data are available which link NAFTA, agriculture, fertilizer use, and reliance on irrigation to water degradation. However, while one author notes that the Mexican Government has estimated the "total value of environmental damages exceeded \$36 billion per annum since 1990,"³² the central government does not appear to have a comprehensive monitoring and data collection effort to assess Mexico's environmental condition. This same author goes on to state "clearly, NAFTA has not been responsible for most, or even a significant portion, of these total environmental damages. However, they underline the fact that economic growth generates considerable pressures on the environment through scale effects."³³ Tied to the lack of environmental regulation enforcement already discussed, lack of data limits conclusions we can draw about the environmental impacts of free trade in Mexico.

Still, available data suggest a number of linkages. For example, while NAFTA cannot account for the amount of wheat production in Mexico (which has remained relatively flat, but is responsible for depletion of groundwater reserves due to a combination of over-pumping and drought), the *type* of wheat has changed. This switch from bread wheat to so-called durum wheat (used primarily in pasta), has led to increased fertilizer use, and increased nitrogen pollution.³⁴ Nitrogen pollution produces an effect known as eutrophication in bodies of water, essentially fueling increased growth of plant life, which reduces oxygen levels, eventually "killing" the water body. While nitrogen pollution is less in Mexico than in major US rivers and basins, such as the Mississippi River and Chesapeake Bay, the "effect is more ecologically destructive in the warmer

³¹ Ibid, p. 62.

³² Ibid, p. 65.

³³ Ibid, p. 66.

³⁴ Ibid, p. 73.

waters of Mexico.”³⁵ But the linkage to NAFTA seems a bit tenuous, as water resource *depletion*, at least, predates the agreement. Herein lays part of the difficulty in judging whether NAFTA has protected or degraded Mexico’s environment and water resources.

I have shown that Mexico depends on irrigation to sustain agriculture. While data indicate most farmland was irrigated prior to the enactment of NAFTA,³⁶ a slight increase in irrigated land has occurred since 1994. More alarming is the depletion of groundwater resources to sustain this irrigation: of the “459 aquifers in the country, more than 80 face high rates of depletion.”³⁷ While I did not locate these depleted aquifers on a map, I hypothesize they are colocated with heavy agriculture, population, and maquiladora activity along the US/Mexico border. Of even greater concern is the use of contaminated wastewater for irrigation. In Tula Valley, Mexico, for example, “about 90,000 ha (hectares) of agricultural land...is irrigated with wastewater from Mexico City, and 62,000 ha of vegetables are grown using water from three watercourses located downstream from Santiago’s sewage outflow.”³⁸ The same authors note that only 41 percent of Mexico’s urban population “is linked to sewerage systems, and over 90 percent of wastewater is discharged into the environment with no treatment.”³⁹ Against this backdrop of environmental inattention, sorting out NAFTA’s environmental effects is difficult at this point.

Progress and Successes

The foregoing data and statistics belie the generally held belief that Mexico’s environment has actually improved in some areas since enactment of NAFTA. One

³⁵ Ibid.

³⁶ Ibid, p. 74.

³⁷ Ibid, p. 75.

³⁸ Ringler, Rosegrant, and Paisner, p. 2.

³⁹ Ibid.

reason is that Mexican law prohibits the import of hazardous wastes⁴⁰, and hazardous wastes generated by the border maquiladoras must be shipped back to the US if the raw materials originated there. This has gone far to limit the “race to the bottom” and “pollution haven” fears many had about NAFTA. Still, while the maquiladoras themselves do not generate a large wastewater stream, wastewater is generated by those who work the plants, as noted earlier.

The US EPA, Mexico’s Secretariat of Environment and Natural Resources (SEMARNAT) and other US and Mexican federal authorities have made progress in treating these kinds of wastewater flows. NAFTA spurred this cooperation, and it is part of the broader US-Mexico environmental program called Border 2012. This program’s number one goal is to “improve water quality through the construction of infrastructure and development of [wastewater] pretreatment programs.”⁴¹ Several severely polluted rivers which flow across the border into the US, including the notorious New River and the Tijuana River, will improve as wastewater treatment plants and centralized sewage systems are developed in Mexico. Moreover, this initiative has focused attention and funds on similar infrastructure needs which exist on the US side of the border, as well.

As discussed, a number of Mexico’s water resources problems were evident prior to NAFTA, such as the heavy reliance on irrigation, and lack of environmental regulation enforcement. Several authors have noted that “policy makes a difference,” and the fact that NAFTA forged a linkage between trade liberalization and environmental protection—in the name of sustainable development—has focused great attention on the

⁴⁰ Marisa Jacott, Cyrus Reed, and Mark Winfield, *The Generation and Management of Hazardous Wastes and Transboundary Hazardous Waste Shipments between Mexico, Canada and the United States, 1990-2000*. May 2001, p. 166.

⁴¹ US-Mexico Border Environmental Program: Border 2012, <http://www.epa.gov/usmexicoborder/>, accessed Feb 4, 2004.

effects of this trade since 1994. Investment in infrastructure is occurring, albeit at a slow pace. NAFTA has therefore helped to mitigate, and also prevent, environmental degradation that would have occurred without this scrutiny. It has also focused attention on the need to strengthen Mexican institutions (environmental or otherwise), and has provided a vehicle to give Mexicans an increased voice in their government. As political scientists, economists, agriculturalists, environmentalists, engineers and others discover the linkages between free trade and environmental protection, NAFTA has the potential to illuminate policy decisions, trade pacts, and environmental protection and enhancement techniques beyond the scope of the present agreement.

Recommendations

A number of avenues exist to strengthen environmental protection under NAFTA. First, efforts currently underway to assess the North American Commission for Environmental Cooperation and the Border Environment Cooperation Commission should receive serious attention, and lead to reform of these agencies.⁴² Procedures to allow citizen involvement in the environmental protection aspects of NAFTA require streamlining; increased access to scientific data is also required. The latter implies more effective environmental policy and regulation, especially in Mexico but also in the US, along the border region. Also needed is some mechanism to compel NAFTA signatories to enforce their own environmental regulations, enact new regulations where needed, and then forge international agreements to govern cross-border pollution. While Mexico and the US have begun to address cross border movement and tracking of hazardous materials, for example, much work remains to be done.

⁴² A report outlining recommendations is due out in the spring of 2004.

Second, both the North American Commission for Environmental Cooperation and the Border Environment Cooperation Commission require increased operating funds, which have not increased in real terms for some time. And, more importantly, the North American Development Bank must structure itself so more high-payoff water projects are pursued: the North American Development Bank can leverage the funds to do this, but has not done so on the scale that is required. While much of this effort depends on a willing—and capitalized—Mexican government, the North American Development Bank is in a position to do more. The priorities the Border Environment Cooperation Commission and the North American Development Bank place on water resources should remain in effect; water resources do indeed appear to be the most pressing, fundamental issue facing Mexico today.

Finally, future free trade agreements in the Americas should be modeled after NAFTA and the two environmental side agreements. Despite the imperfect linkage between trade and environmental protection seen thus far, NAFTA has made a positive difference in environmental quality and sustainable development, focusing scrutiny and shining light on problems that would have otherwise languished. Indeed, policy does make a difference.